

# A critical review of the Mediterranean sea turtle rescue network: a web looking for a weaver

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## Abstract

A key issue in conservation biology is recognizing and bridging the gap between scientific results and specific action. We examine sea turtles—charismatic yet endangered flagship species—in the Mediterranean, a sea with historically high levels of exploitation and 22 coastal nations. We take sea turtle rescue facilities as a visible measure for implemented conservation action. Our study yielded 34 confirmed sea turtle rescue centers, 8 first-aid stations, and 7 informal rescue institutions currently in operation. Juxtaposing these facilities to known sea turtle distribution and threat hotspots reveals a clear disconnect. Only 14 of the 22 coastal countries had centers, with clear gaps in the Middle East and Africa. Moreover, the information flow between centers is apparently limited. The populations of the two species nesting in the Mediterranean, the loggerhead *Caretta caretta* and the green turtle *Chelonia mydas*, are far below historical levels and face a range of anthropogenic threats at sea and on land. Sea turtle rescue centers are acknowledged to reduce mortality in bycatch hotspots, provide a wealth of scientific data, and raise public awareness. The proposal for a Mediterranean-wide rescue network as published by the Regional Activity Centre for Specially Protected Areas a decade ago has not materialized in its envisioned scope. We discuss the efficiency, gaps, and needs for a rescue network and call for establishing additional rescue centers and an accompanying common online database to connect existing centers. This would provide better information on the number and types of rescue facilities on a Mediterranean scale, improve communication between these facilities, enhance standardization of procedures, yield large-scale data on the number of treated turtles and their injuries, and thus provide valuable input for targeted conservation measures.

## Keywords

Mediterranean Sea, marine turtles, conservation, rescue facilities, first aid, rehabilitation, information management, networking, awareness raising

## Introduction

Conservation biology is called upon to help translate scientific knowledge into specific action. Bridging this gap has been abetted by a new era of scientific endeavor (Stachowitsch 2003, Rose et al. 2011) in which the focus and urgency of scientific work has changed. In marine biology, a considerable and increasing percentage of papers is being devoted to documenting deterioration and dysfunction at population, ecosystem and global levels, often suggesting amelioration strategies. This is particularly true in the case of sea turtles, well-known flagship species, which face major anthropogenic threats at sea and on their nesting beaches worldwide. The complex life-history and highly migratory nature of sea turtles (Hamann et al. 2010), combined with the many human impacts, make conservation challenging and transcend simple, contained management measures. All sea turtle species are listed on The IUCN Red List of Threatened Species (IUCN 2014). They are a case study of marine megafauna that are now functionally or entirely extinct in many coastal ecosystems (Jackson et al. 2001).

The Mediterranean is a historically overexploited marginal sea (Morales-Muñiz and Roselló-Izquierdo 2008). It is also polluted, for example with oil and plastic, which are particularly pertinent with regard to sea turtles (Graentz 1988). Its multitude of coastal nations with different socio-economic and cultural backgrounds—not to mention linguistic barriers—stymies the concerted protection and conservation of its sea turtle populations (Amano and Sutherland 2013). The loggerhead *Caretta caretta* (Linnaeus, 1758) is the most common species in the Mediterranean (Broderick et al. 2002, Margaritoulis et al. 2003). Like the green turtle *Chelonia mydas* (Linnaeus, 1758), it nests in the eastern regions (Kasperek et al. 2001, Margaritoulis et al. 2003), but also frequents different habitats during different life stages in the western sector (Garofalo et al. 2013), where it co-occurs with individuals from the Atlantic (Carreras et al. 2006, Casale et al. 2008a, Wallace et al. 2010). Leatherbacks *Dermochelys coriacea* (Vandelli, 1761) are observed regularly at sea (Casale et al. 2003), whereas the hawksbill turtle *Eretmochelys imbricata* (Linnaeus, 1766) and Kemp's ridley *Lepidochelys kempii* (Garman, 1880) are recorded here only occasionally (Laurent and Lescure 1994, Camiñas 2003). Sea turtles have been afforded protection under a number of treaties and laws (Suppl. material 1). The EU Habitats Directive lists all five species in Annex IV as being of community interest and in need of strict protection (European Community 1992). It also protects the loggerhead and green turtle as priority species with the need for special conservation areas (Annex II). Accordingly, these two species are subject to wide-ranging scientific research, monitoring, and conservation efforts by dozens of universities and institutions, along with numerous dedicated associations and societies, e.g., ARCHELON, EuroTurtle, MEDASSET.

Fisheries bycatch, boat strikes, intentional killing, and entanglement in marine debris including ghost gear have been identified as the main threats at sea (Tomás et al. 2008, Casale and Margaritoulis 2010, Casale et al. 2010, Casale 2011). On land, degradation and reduction of nesting habitat caused by touristic and recreational

activities, light pollution, noise, construction, sand extraction, and traffic (Camiñas 2004) are taking their toll. Turkey, for example, holds the largest green turtle nesting population in the Mediterranean with about 230 females nesting annually (Seminoff 2004). Only three generations back, from 1879–1919, about 3,500 individuals still nested there (Seminoff 2004). The Turkish population has experienced a 93% decline over the last 95 years. Green turtles face a measurable risk of extinction worldwide and therefore qualify for the IUCN Endangered status under Criteria A2bd (Seminoff 2004). The Mediterranean population is genetically distinct from Atlantic populations and belongs to a separate regional management unit (RMU) (Wallace et al. 2010), which is recognized to face high threats and a high risk of extinction (Wallace et al. 2011). A total of 339–369 females are nesting in the entire Mediterranean (Broderick et al. 2002).

The resident Mediterranean loggerhead population is genetically isolated (Carreras et al. 2011) from individuals of the two Atlantic RMUs migrating to Mediterranean foraging grounds and is considered to face high threats (Wallace et al. 2011). Bycatch rates are estimated at up to 200,000 loggerheads per year, leading to more than 50,000 deaths annually through direct interaction alone (Casale 2008, Lucchetti and Sala 2010, Casale 2011). Considerable declines on specific nesting beaches have been recorded (Ilgaz et al. 2007). Overall, no significant population trend could be observed on nesting beaches over the last decades, but survival probabilities are somewhat lower than would be expected from a healthy population (Casale et al. 2014). Anecdotal information suggests a decline over decadal scales (Casale and Margaritoulis 2010). The latest IUCN assessment classified the loggerhead as vulnerable (Marine Turtle Specialist Group 1996) but did not specifically deal with the Mediterranean population and needs updating (IUCN 2014). Total population estimates are not available, neither are total stock mortality estimates (Camiñas 2004).

The importance of dedicated rescue facilities for sea turtles was recognized during the 1980s (RAC/SPA 2004). One of the first rescue centers in the Mediterranean was established by ARCHELON in Greece in 1994 (Suppl. material 1). Others followed, but not all of them provided full facilities and treatment (Bentivegna 2005). After two decades of ill-concerted development, the need for regulating and improving sea turtle rescue was generally acknowledged, and guidelines for the standardization of rescue activities were established. The Regional Activity Centre for Specially Protected Areas (RAC/SPA) published a rough outline of a Mediterranean-wide sea turtle rescue network. It should consist of sea turtle rescue centers and first-aid stations (hereafter referred to as STRCs and FASTs, respectively) strategically based along the coasts, each adhering to common established guidelines of conduct (RAC/SPA 2004). RAC/SPA proposed to potentially act as the network's international coordinator (see Suppl. material 1 for more details).

The most obvious function of STRCs and FASTs is the rescue and rehabilitation of individual turtles. STRCs, though “in the last line of defense”, are a management tool that acts on a number of fronts. Firstly, they help increase adult and subadult survival rates, a major priority in conservation action (Camiñas 2004) that has a

considerable effect at the population level. STRCs play a significant role in reducing indirect mortality of stranded, injured or comatose adults, and large juveniles. These are size classes typically affected by the two major threats at sea: bycatch and ship strikes. Adult survival is the main factor in population growth rates; large juveniles have a high reproductive value (Wallace et al. 2008). Modeling approaches show that population persistence is much more sensitive to the survival of older age classes than to that of the first year cohort, i.e., eggs and hatchlings (Chaloupka 2002, Mazaris et al. 2005, Mazaris et al. 2006). Secondly, research is an acknowledged function of STRCs (RAC/SPA 2004). STRCs are often linked to stranding network activities. They provide a wealth of scientific data (Shaver and Teas 1999, Casale et al. 2010) on each stranded or floating turtle, including the nature of their injuries. Stranding records represent a valuable source of information on both mortality factors and spatio-temporal distribution (Casale et al. 2010). Thirdly, awareness campaigns targeting fishers to reduce post-release mortality of bycaught turtles are an urgent priority mitigation measure (Casale et al. 2007a, Ech Wikhi et al. 2012, Domènech et al. 2014). RAC/SPA (2004) acknowledged the importance of STRCs in sensitizing fishers to the plight of sea turtles through awareness programs, handling workshops, and promoted cooperation between fishers and conservation biologists. Thusly trained fishers are more likely to bring in comatose turtles for medical treatment before releasing them back into the sea (Casale et al. 2007a, Domènech et al. 2014). They are also more likely to adopt the simple onboard handling procedures (Gerosa and Aureggi 2001) that can considerably reduce indirect mortality of bycaught turtles. Fourthly, public awareness campaigns also target non-professionals, who may visit STRCs and partake in educational activities or volunteer. STRCs therefore bridge the gap between science and everyday life. They can get people involved in the conservation cause and potentially initiate a public conservation movement (Casale et al. 2007a).

Despite these efforts, clear gaps remain in the protection of Mediterranean sea turtles. In trawl fisheries, for example, proven management strategies such as turtle excluder devices (TEDs) are not routinely employed (Laurent et al. 1996, Casale et al. 2004), but their future use in EU waters is currently being discussed. Outdated fishing gear is apparently sold to non-EU countries, perpetuating illegal fishing practices in both larger-scale and artisanal fisheries (Lucchetti and Sala 2010). Bycatch in the latter, small-scale fisheries can even exceed levels in industrial fisheries (Lewison et al. 2014) and is particularly relevant in the Mediterranean (Ech Wikhi et al. 2012). This adds to the urgency of a functioning and tight-knit rescue network and supraregional awareness programs.

We take the number of rescue facilities as a visible measure for practical progress in sea turtle conservation and provide an update on currently operating facilities (STRCs, FASTs, informal or temporary institutions) with verified contact details and information on the history of each center (Table 1). We then examine whether the coverage of rescue facilities correlates with threat hotspots and the distribution, including nesting sites, of the two sea turtle species nesting in the Mediterranean, and whether the

**Table 1.** Sea turtle rescue facilities in the Mediterranean. Based on literature search, available internet data, and personal communications. All listed websites were last accessed on 8 Feb. 2015, with final updates April 2015. All given contact details were confirmed by staff members of the respective rescue facilities, unless stated otherwise. Encompasses 20 countries bordering the Mediterranean, along with the islands of Cyprus and Malta (Northern Cyprus: self-declared state; Gibraltar: British Overseas Territory; Ceuta and Melilla: Spanish autonomous cities on the N. African coast). Countries and rescue facilities listed in alphabetical order. Italian rescue facilities ordered alphabetically by administrative region. Names of contact persons without academic titles. FAST, first-aid station; FI, figure icon; corresponding icon in Figs 1–2; IRE, informal or temporary rescue facility; NP, National Park; STRC, sea turtle rescue center.

Country	FI	Type	Contact details & additional information
Albania, ALB	!	STRC	Planned for 2014: establishment of a STRC in Patok, NW-Albania, within the framework of the IPA Adriatic CBC Programme, co-funded by the EU (Sajmir Begiraj, University of Tirana, personal communication, 8 Feb. 2014).
Algeria, DZA			No data available.
Bosnia–Herzegovina, BIH		—	No sea turtle rescue facilities (Tarik Kupusović, Hydro-Engineering Institute Sarajevo, personal communication, 24 July 2013).
Croatia, HRV	1	STRC	Blue World Institute of Marine Research and Conservation, Sea Turtle Rescue Center, Lošinj Marine Education Centre, Kaštel 24, 51551 Veli Lošinj, www.blue-world.org (section “News/July 2013”), Contact person: Jelena Basta (Education director), Email: info@blue-world.org, jelena.basta@blue-world.org, Tel.: (+385) 51–604666, Cell: (+385) 91–6046667. Opened on 19 July 2013. Part of NETCET (Network for the Conservation of Cetaceans and Sea Turtles in the Adriatic, co-funded by the EU IPA Adriatic CBC Programme), http://www.netcet.eu/.
	2	STRC	Marine Educational Centre Pula, Marine Turtle Rescue Centre, Aquarium Pula, Fort Verudela, Verudela bb, 52105 Pula, http://www.aquarium.hr/, Contact person: Karin Gobić Medica, Email: infos@aquarium.hr, karin@aquarium.hr, Tel.: (+385) 52–381402, Cell: (+385) 91–1381414. Part of NETCET, http://www.netcet.eu/.
Cyprus, CYP	3	STRC	CyMARC, Cyprus Marine Aquaculture Research Center, c/o Ministry of Agriculture, Natural Resources and Environment, Marine Environment Division, Department of Fisheries & Marine Research (DFMR), 1416 Nicosia, http://www.moa.gov.cy/moa/dfmr/dfmr.nsf/DMILAqa_en/DMILAqa_en, Contact persons: George Anastasiades (Responsible scientist), Email: director@dfmr.moa.gov.cy, Tel.: (+357) 24–422888, Marina Argyrou (Senior Fisheries and Marine Research Officer), Email: margyrou@dfmr.moa.gov.cy, Tel.: (+357) 22–807852. Located at Meneou, Larnaca; formerly known as Meneou Marine Research Station (MeMARS).
Northern Cyprus, CTR		—	No sea turtle rescue facilities (Wayne Fuller, European University of Lefke, Society for the Protection of Turtles (SPOT), Marine Turtle Conservation Project (MTCP), personal communication, 25 Jan. 2014).
Egypt, EGY	!	IRF	Monitoring takes place every year; veterinarians take care of injured and stranded sea turtles in the field (Moustafa Fouda, Ministry of State for Environmental Affairs, Nature Conservation Sector, personal communication, 21 Jan. 2014).
France, FRA	4	STRC	Centre d’Etudes et de Sauvegarde des Tortues Marines de Méditerranée, Avenue du Palais de la Mer, BP 106, 30240 Le Grau-du-Roi, www.cestmed.org, Contact person: Jeanbaptiste Senegas, Email: contact@cestmed.org, Tel.: (+33) 4–66515737, Cell: (+33) 6–24475155.

Country	FI	Type	Contact details & additional information
Corsica	!	IRF	Local network dedicated to sea turtle research and rescue, <a href="http://www.corsenetinfos.fr/Un-reseau-d-alerte-tortues-marines-en-Corse_a10556.html">http://www.corsenetinfos.fr/Un-reseau-d-alerte-tortues-marines-en-Corse_a10556.html</a> . Part of the French Mediterranean Sea Turtle Network (Réseau Tortues Marines de Méditerranée Française, RTMMF, <a href="http://lashf.fr/laSHF/commissions/RTMMF">http://lashf.fr/laSHF/commissions/RTMMF</a> ). Ongoing collaboration with the nearby Sardinian STRC of Asinara (see Nr. 29) (Michel-Jean Delaugerre, personal communication, 21 April 2015).
Gibraltar, GIB	!	IRF	Helping Hand Trust, 10, Queensway Quay, <a href="http://www.helpinghandgi/">http://www.helpinghandgi/</a> , Tel.: (+350) 200–73719, Emergency numbers: (+350) 200–72500, 199 (Police), or (+350) 200–65964 (Department of the Environment). Calls will be redirected to the rescue team. The organization takes care of sea turtles together with veterinarians from the Gibraltar Veterinary Clinic and representatives of the Department of the Environment. (Stephen Warr, H.M. Government of Gibraltar, Department of the Environment, personal communication, 21 Jan. 2014).
Greece, GRC	5	FAST	ARCHELON, Sea Turtle Protection Society of Greece (STPS), First Aid Station, Amvrakikos Bay (Kopraina), <a href="http://www.archelon.gr/">http://www.archelon.gr/</a> , Contact person: Pavlos Tsaros, Email: <a href="mailto:rescue@archelon.gr">rescue@archelon.gr</a> , Cell: (+30) 697–2877962.
Israel, ISR	6	FAST	ARCHELON, Sea Turtle Protection Society of Greece (STPS), First Aid Station, Pagalohori of Rethymno, Arkadi, Crete, <a href="http://www.archelon.gr/">http://www.archelon.gr/</a> , Contact person: Reggina Stefanatou, Email: <a href="mailto:archelon.crete@gmail.com">archelon.crete@gmail.com</a> , Cell: (+30) 693–7352379.
Italy, ITA	7	STRC	ARCHELON, Sea Turtle Protection Society of Greece (STPS), Sea Turtle Rescue Centre, 3 <sup>rd</sup> Marina, Glyfada 16675, Athens, <a href="http://www.archelon.gr/">http://www.archelon.gr/</a> , Contact person: Pavlos Tsaros, Email: <a href="mailto:rescue@archelon.gr">rescue@archelon.gr</a> , Tel.: (+30) 21–08944444, Cell: (+30) 694–1511511.
Basilicata	8	STRC	Hellenic Centre for Marine Research (HCMR), Hydrobiological Station of Rhodes, Sea Turtle Rescue Centre, Cos Street, 85100 Rhodes, <a href="http://www.hcmr.gr">www.hcmr.gr</a> , Contact person: Maria Corsini-Foka, Email: <a href="mailto:hsr@hsr-ncmr.gr">hsr@hsr-ncmr.gr</a> , Tel.: (+30) 2241–027308, (+30) 2241–078320.
Calabria	9	STRC	Israel Sea Turtle Rescue and Rehabilitation Center, Mevo'ot Yam, Mikhmoret, <a href="http://old.parks.org.il/">http://old.parks.org.il/</a> , Contact person: Yaniv Levy (Sea turtle project coordinator, STRC-Director, ISRAEL National Nature and Parks Authority), Email: <a href="mailto:Israelseaturtle@npa.org.il">Israelseaturtle@npa.org.il</a> , <a href="mailto:yaniv@npa.org.il">yaniv@npa.org.il</a> , Tel.: (+972) 9–8669173, Emergency number: *6911 (Speed dial service).
			National emergency numbers, toll free: 1530 (National Coast Guard), 800–904841 (Europ Assistance Service “SOS tartarughe”, <a href="http://www.europassistance.it/azienda/progetto-tartanet/">http://www.europassistance.it/azienda/progetto-tartanet/</a> ). Calls will be redirected to the nearest rescue center. (Daniela Casprini, Associazione Vittime della Caccia, personal communication, 21 July 2013).
	10	STRC	Centro di recupero tartarughe marine di Policoro, Via Lido, 75025 Policoro (MT), Email: <a href="mailto:policoro@leganavale.it">policoro@leganavale.it</a> , Tel.: (+39) 0835–403814, Cell: (+39) 335–1272335, Contact person: Raffaele Micelli (Educational director), Cell: (+39) 335–1272336. Founded by the sailing club “Circolo Velico Lucano” in 1999, <a href="http://www.circolovelicolucano.it/">http://www.circolovelicolucano.it/</a> (news postings). Located in the Nature Reserve “Bosco Pantano”. <a href="http://www.tartanet.it/">http://www.tartanet.it/</a> .
	11	FAST	Oasi WWF Pollicoro Herakleia, Riserva Regionale “Bosco Pantano”, C.R.A.S. (Wildlife Rescue Center), Piazza Siris, Località Idrovora, 75025 Policoro (MT), <a href="http://www.oasiwwfpolicoro.net/">http://www.oasiwwfpolicoro.net/</a> , Contact person: Antonello Palmisano, Email: <a href="mailto:wwf.poli@gmail.com">wwf.poli@gmail.com</a> , Tel.: (+39) 0835–1825157. The center is part of WWF Italy's Sea Turtle Network and provides first aid through a team of veterinarians and marine biologists. Temporary holding tanks are available. Turtles in need of surgery are transferred to the Veterinary Hospital of Bari.
	12	STRC	Centro Recupero Tartarughe Marine Brancalene, Piazza Stazione, Brancalene Marina, 89036 Brancalene (RC), <a href="http://www.naturalmentebrancalene.org/">http://www.naturalmentebrancalene.org/</a> , Email: <a href="mailto:naturalmentebrancalene@gmail.com">naturalmentebrancalene@gmail.com</a> , Cell: (+39) 328–3020921, (+39) 340–1290736. (Simona Clò, formerly in charge of the now partly defunct rescue network “Tartanet”, personal communication, 27 Jan. 2014).

Country	FI	Type	Contact details & additional information
			Sea Turtle Rescue and Rehabilitation Center, Area Marina Protetta “Capo Rizzuto”, Centro Direzionale, Via C. Colombo, 88900 Crotone (KR), <a href="http://www.ampcaporizzuto.it/">http://www.ampcaporizzuto.it/</a> (news postings), Email: segreteria@ampcaporizzuto.it, Tel.: (+39) 0962–665254, Contact person (administrative): Simone Scalise, Email: scalise@ampcaporizzuto.it, Contact persons (technical & scientific): Pierfrancesco Cappa, Domenico Piro (Veterinarian). The MPA has joined the National Action Plan for the Conservation of Sea Turtles (PATMA). It is collaborating with WWF Calabria, and the Universities of Calabria, Pisa, and Bari. The STRC was funded by the state, region, province, and the EU. It is run by MPA staff and through the help of volunteers. Turtles are rehabilitated in the Aquarium in Capo Rizzuto, where CEAM, the Environmental Education Center, pursues public information activities.
13	STRC		Centro di Recupero Tartarughe Marine di Punta Campanella, Via Padre Rocco 40, 80061 Massa Lubrense (NA), Email: cea@puntacampanella.org, Tel.: (+39) 081–8089877. <a href="http://www.tartanet.it/">http://www.tartanet.it/</a> .
Campania	14	STRC	Sea Turtle Rescue Centre, Stazione Zoologica Anton Dohrn, Villa Comunale, 80121 Napoli, <a href="http://www.szn.it/SZNWeb/showpage/115?_languageId_=2">http://www.szn.it/SZNWeb/showpage/115?_languageId_=2</a> , Contact person: Sandra Hochscheid, Email: sandra.hochscheid@szn.it, Tel.: (+39) 081–5833222.
	15	STRC	Turtle Point, Sea Turtle Rescue and Rehabilitation Centre, Stazione Zoologica Anton Dohrn, Via Coccchia 28, 80124 Bagnoli (NA), <a href="http://www.szn.it/SZNWeb/showpage/115?_languageId_=2">http://www.szn.it/SZNWeb/showpage/115?_languageId_=2</a> , Contact person: Sandra Hochscheid, Email: aquarium@szn.it, sandra.hochscheid@szn.it, Tel.: (+39) 081–7629338. Specialized in rehabilitation phase after treatment and prior to reintroduction into the wild.
Emilia–Romagna	16	STRC	ARCHE’, Via Mulinetto 40/a, 44100 Ferrara (FE), Email: archeturtle@tiscali.it, Tel.: (+39) 0532–767852. (Daniela Casprini, Associazione Vittime della Caccia, personal communication, 17 July 2013).
	17	STRC	Fondazione Cetacea Onlus, Viale Torino 7/A, 47838 Riccione (RN), <a href="http://fondazionecetacea.org/">http://fondazionecetacea.org/</a> , Contact person: Valeria Angelini, Email: informazione@fondazionecetacea.org, educazione@fondazionecetacea.org, Tel.: (+39) 0541–691557. Part of NETCET, <a href="http://www.netcet.eu/">http://www.netcet.eu/</a> .
Friuli–Venezia Giulia	18	STRC	WWF Area Marina Protetta di Miramare, Cetacean and Sea Turtle Monitoring and First Aid Group, Viale Miramare 349, 34151 Grignano–Trieste (TS), <a href="http://www.riservamarinamiramare.it/">http://www.riservamarinamiramare.it/</a> (news postings), Contact person: Francesco Zuppa, Email: info@riservamarinamiramare.it, zuppa@riservamarinamiramare.it, Tel.: (+39) 040–224147. Part of WWF Italy’s Sea Turtle Network.
	19	FAST	Centro cura tartarughe marine, Università degli Studi di Bari Aldo Moro, Facoltà di Medicina Veterinaria, Piazza Umberto I 1, 70121 Bari (BA), <a href="http://www.uniba.it/ricerca/dipartimenti/dipmedveterinaria/strutture/centro-cura-tartarughe-marine/">http://www.uniba.it/ricerca/dipartimenti/dipmedveterinaria/strutture/centro-cura-tartarughe-marine/</a> , Emergency number, toll free: 800–883046. (Daniela Casprini, Associazione Vittime della Caccia, personal communication, 21 July 2013).
Puglia	20	STRC	Centro Recupero Tartarughe Marine del Salento, Parco Naturale Regionale Bosco e Paludi di Rauccio, 73100 Lecce (LE), <a href="http://www.salento.com/il-salento/varie/centro-recupero-tartarughe-marine-crtm-del-salento">http://www.salento.com/il-salento/varie/centro-recupero-tartarughe-marine-crtm-del-salento</a> . (Chiara Caputo, CRTM Museo di Calimera, personal communication, 30 July 2013). <a href="http://www.tartanet.it/">http://www.tartanet.it/</a> .
	21	STRC	Centro Recupero Tartarughe Marine Manfredonia–Legambiente, Parco Nazionale del Gargano, Oasi Lago Salso, 71043 Manfredonia (FG). (Simona Clò, formerly in charge of the now partly defunct rescue network “Tartanet”, personal communication, 27 Jan. 2014).
22	STRC		CRTM Museo di Calimera, SP 275 Calimera–Borgagne, km 1, 73021 Calimera (LE), <a href="http://www.msns.it/">http://www.msns.it/</a> , Contact person: Chiara Caputo, Email: osservatorio.faunistico@msns.it, Cell: (+39) 324–8898814, (+39) 320–6586558.
23	STRC		

Country	FI	Type	Contact details & additional information
			Public emergency number, toll free: 1515 (Sardinian Forest Service). In addition to national emergency numbers, see above. The nearest rescue team will be alerted. All of the following Sardinian rescue facilities operate within the Sardinian Regional Network for the Conservation of Marine Turtles and Mammals.
24	FAST		Area Marina Protetta di Tavolara Punta Coda Cavallo, Via Dante 1, 07026 Olbia (OT), <a href="http://www.ampravolara.com">www.ampravolara.com</a> , Contact person: Pier Panzalis, Email: ambiente@ampravolara.it, Office/Emergency Tel.: (+39) 0789–203013. Turtles in need of veterinary treatment will be transferred to CReS in Oristano (see Nr. 25).
25	STRC		Area Marina Protetta “Penisola del Sinis—Isola di Mal di Ventre”, Centro di Recupero del Sinis delle tartarughe marine e dei cetacei (CReS), Office: Piazza Eleonora 1, 09072 Cabras (OR), Email: ambiente@areamarinasinis.it, Office Tel.: (+39) 0783–391097. Rescue center located at IAMC-CNR (National Research Council), Loc. Sa Mardini, 09170 Oristano (OR), <a href="http://www.areamarinasinis.it">http://www.areamarinasinis.it</a> , Contact person (administrative): Giorgio Massaro, Email: direzione@areamarinasinis.it, Cell (Emergency): (+39) 340–1096633, Contact person (technical & scientific): G. Andrea de Lucia (Scientific coordinator), Email: a.delucia@iamc.cnr.it, Cell (Emergency): (+39) 339–4654779.
Sardegna	26	FAST	Centro di Primo Soccorso “Capo Carbonara”, Via degli Asparagi 51/a, 09049 Villasimius (CA), <a href="http://www.ampcapocarbonara.it/pagina.php?id=48">http://www.ampcapocarbonara.it/pagina.php?id=48</a> , Contact persons (Biologists): Francesca Frau, M. Francesca Cinti, Fabrizio Atzori, Email: info@ampcapocarbonara.it, Tel.: (+39) 070–790234, Cell (Emergency): (+39) 320–4643038. The center, formerly a “node” of the regional rescue network, is presently in phase of acknowledgement as an official FAST by the Ministry of the Environment. Expected new address: Via degli Oleandri 6/b, 09049 Villasimius (CA).
	27	STRC	Centro Recupero Cetacei e Tartarughe marine “Laguna di Nora”, Centro di educazione ambientale Laguna di Nora, Laguna di Nora Loc. Nora, 09010 Pula (CA), <a href="http://www.lagunadinora.it/sezione.php?idsez=5">http://www.lagunadinora.it/sezione.php?idsez=5</a> , Contact person: Giuseppe Ollano, Email: info@lagunadinora.it, gollano@lagunadinora.it, Tel.: (+39) 070–9209544. The center is managed on behalf of the Municipality of Pula.
	28	FAST	First Aid Station, National Park “Arcipelago di la Maddalena”, <a href="http://www.lamaddalenapark.it/">http://www.lamaddalenapark.it/</a> (news postings), Email (NP Environmental Office): ufficio.ambiente@lamaddalenapark.org. The FAST is located in the park’s Environmental Education Center in Stagnali on Isola Caprera. Contact person: Yuri Donno, Tel.: (+39) 0789–790233. For 2014, regional funding was expected, and a new operational plan, regarding the coordination of wildlife rescue operations through a specialized company, was being devised. The NP will continue giving first aid and providing public information services.
	29	STRC	Parco Nazionale dell’Asinara, Area Marina Protetta “Isola dell’Asinara”, Centro Recupero Animali Marini, Cala Reale, Isola dell’Asinara, 07046 Porto Torres (SS), <a href="http://www.parcoasinara.org">www.parcoasinara.org</a> , <a href="http://www.cramasina.org">http://www.cramasina.org</a> , General information: parco@asinara.org, enteparcoasinara@pec.it, Emergency contact: Associazione CRAMA, which manages the rescue center on behalf of the NP. Email: info@cramasina.org, Cell: (+39) 340–8161772.
Sicilia	!	STRC	Centro Recupero Provinciale Fauna Selvatica e Tartarughe Marine, SP 29, 92011 Cattolica Eraclea (AG), Contact person: Calogero Lentini (Veterinarian), Email: addolentini@alice.it, Additional information: <a href="http://www.tartanet.it/">http://www.tartanet.it/</a> . The center was closed in Dec 2013. Reopening is planned but not scheduled yet. (Simona Clò, formerly in charge of the now partly defunct rescue network “Tartanet”, personal communication, 27 Jan. 2014).

Country	FI	Type	Contact details & additional information
30	STRC	Centro Recupero Tartarughe Marine di Linosa	Via Pozzolana di Ponente 13, 92010 Linosa (AG), <a href="http://www.marineturle.it/">http://www.marineturle.it/</a> , Contact person: Stefano Nannarelli (Director), Email: Info@marineturtle.it, Tel.: (+39) 0922-972076.
31	STRC	Centro Soccorso e Cura Tartarughe Marine, WWF Italia, Stazione Marittima 92010 Lampedusa (AG)	<a href="http://www.lampedusaturterescue.org/">http://www.lampedusaturterescue.org/</a> , Contact person: Daniela Freggi (Director), Email: dafregg@tin.it, Tel.: (+39) 338-2198533.
32	STRC	DELPHIS Aeolian Dolphin Center, Via Simone Neri 1, 98050 S. Marina Salina, Isola di Salina, Isole Eolie (ME)	<a href="http://www.delphisadc.it/">http://www.delphisadc.it/</a> , Contact person: Renata Mangano (Coordinator), Email: delphiscenter@gmail.com, Cell (Emergency): (+39) 333-1932002. DELPHIS takes care of sea turtles and cetaceans in the Aeolian Islands.
33	FAST	Filicudi Wildlife Conservation, Pronto Soccorso 'Tartarughe Marine dell' Arcipelago Eoliiano, Office: Località Stimpagnato, Isola di Filicudi, 98055 Lipari (ME)	<a href="http://www.filicudiconservation.com/">http://www.filicudiconservation.com/</a> , Email: info@filicudiconservation.com, Cell: (+39) 349-4402021. The FAST is located at Hotel Phenicusa, Via Porto 7, 98050 Filicudi, Isole Eolie (ME). The Visitor Information Center is located in Piazzetta Pecorini Mare, Filicudi (ME). (Sources: <a href="http://www.filicudiconservation.com/">http://www.filicudiconservation.com/</a> , <a href="http://www.oraresorphenicus.com/">http://www.oraresorphenicus.com/</a> )
34	STRC	NECTON Marine Research Society, Office for East Sicily: Via Guido Gozzano 47, 95100 Catania; Office for West Sicily: Via Celona 11, 98165 Ganzirri Messina; <a href="http://www.necton.it/">http://www.necton.it/</a> , Contact person: Renata Mangano (Coordinator), Email: info@necton.it, Cell (Emergency): (+39) 333-1932002.	
Toscana	!	IRF	Acquario di Livorno, Piazzale Mascagni 1, 57127 Livorno (LI), <a href="http://www.acquariodilivorno.it/">http://www.acquariodilivorno.it/</a> , Email: info@acquariodilivorno.it, Tel.: (+39) 0586-269111/154 (in case of emergency, ask for the Aquarium Department). The Aquarium takes care of injured and stranded sea turtles along the coast of Tuscany, together with Costa Edutainment's veterinarians and specialists. It provides holding tanks for treatment and rehabilitation. The ultimate aim is the animals' reintroduction into the wild.
	36	STRC	Centro didattico WWF dei Ronchi, Centro di educazione ambientale e Centro recupero tartarughe marine, Via Donizetti, Località Ronchi, 54038 Marina Di Massa (MS), <a href="http://centrodidatticowfronchi.wordpress.com/">http://centrodidatticowfronchi.wordpress.com/</a> , Contact person: Gianluca Giannelli (Director), Email: parcodidattico@virgilio.it, Cell: (+39) 360-234789. Reopened on 3 August 2013. (Paolo Casale, Scientific coordinator of the Sea Turtle Project WWF Italy, personal communication, 29 Jan 2014)
Lebanon, LBN			No data available.
Libya, LBY	?	STRC	Marine Biology Research Centre (MBRC) Tajura, PO Box: 30830 Tajura (Casale and Margaritoulis 2010, <a href="http://www.ciesm.org/online/institutes/inst142.htm">http://www.ciesm.org/online/institutes/inst142.htm</a> ). Status unknown.
Malta, MIT	!	IRF	Nature Trust Malta ( <a href="http://www.naturetrustmalta.org">www.naturetrustmalta.org</a> ) runs a temporary rehabilitation center located at Malta Aquaculture Research Centre, San Lucjan Tower, Marsaxlokk A permanent center is planned at Xrobb I-Għagin in Dellimara. Contact persons: Vincent Attard, Karen Goode, Responsible veterinarian: Anthony Grupetta, Email: info@naturetrustmalta.org, Cell (Emergency): (+356) 9999-9505.
Monaco, MCO	37	STRC	Musée océanographique, Institut océanographique, Fondation Albert 1er, Prince de Monaco, Av. Saint-Martin, MC 98000 Monaco, <a href="http://www.oceano.mc/en/activities/activities-for-all/-the-museum-involved-in-helping-turtles">http://www.oceano.mc/en/activities/activities-for-all/-the-museum-involved-in-helping-turtles</a> , Contact person: Pierre Gilles (Head of Aquarium), Email: p.gilles@oceano.mc, Tel.: (+377) 93153646. Part of the French Mediterranean Sea Turtle Network (Réseau Tortues Marines de Méditerranée Française, RTMMF).

Country	FI	Type	Contact details & additional information
Montenegro, MNE	—	No sea turtle rescue facilities (Milena Bataković, Environmental Protection Agency of Montenegro, Department for nature protection, monitoring, analysis and reporting, personal communication, 22 July 2013).	
Morocco, MAR	!	IRF	ATOMM (Association de protection des Tortues Marines au Maroc), Department of Biology, Faculty of Science, PO Box 2121, Tétouan 93002 Morocco, <a href="http://www.atomm.org/">http://www.atomm.org/</a> , Contact person: Mustapha Aksissou (Director), Email: <a href="mailto:akssou@yahoo.fr">akssou@yahoo.fr</a> , Cell: (+212) 661–953689.
Palestine, State of, PSE			No data available.
Slovenia, SVN	!	IRF	Aquarium Piran, Kidričeve nabrežje 4, 6330 Piran–Piran, Tel.: (+386) 5–1602554, Contact person: Valter Žiža, Email: <a href="mailto:akvarij.piran@guest.arnes.si">akvarij.piran@guest.arnes.si</a> , Cell: (+386) 41–975386; Golob d.o.o., Zatočišče za živali prostot živečih vrst, Glavni trg 7, 2366 Muta, Tel.: (+386) 2–8761285, Contact person: Zlatko Golob, Cell: (+386) 41–518939. Veterinarians of the Wildlife Sanctuary “Zatočišče za živali prostot živečih vrst” take care of injured sea turtles. Aquarium Piran provides space for first aid treatment; it does not, however, have holding tanks for a longer rehabilitation phase.
Spain, ESP	38	STRC	Centro de Recuperación de Animales Marinos de la Fundación CRAM, Passeig de la Platja 28–30, 08820 El Prat de Llobregat (Barcelona), <a href="http://cram.org/">http://cram.org/</a> , Contact person: Elsa Jiménez, Email: <a href="mailto:info@cram.org">info@cram.org</a> , Tel.: (+34) 937–524581.
	39	STRC	Centro de Recuperación de Especies Marinas Amenazadas, CREMA, de Málaga, Calle Pacífico 80, 29003 Málaga, <a href="http://www.auladelmar.info/crema">http://www.auladelmar.info/crema</a> , Contact person: José Luis Mons Checa, Email: <a href="mailto:crema@auladelmar.info">crema@auladelmar.info</a> , Tel.: (+34) 952–229287, Emergency number: 112.
Ceuta	40	STRC	Centro de Recuperación de Fauna La Granja de El Saler, Av de los Pinares 106, 46012 El Saler, Valencia, Contact person: Juan Eymar, Email: <a href="mailto:centre_granja@gva.es">centre_granja@gva.es</a> , Tel.: (+34) 96–961610847. Local government property.
Melilla			No data available.
Syria, SYR	—	No sea turtle rescue facilities (Alan F. Rees, IUCN Marine Turtle Specialist Group (MTSG) Regional Vice Chair for the Middle East Region, personal communication, 24 Jan. 2014).	
Tunisia, TUN	41	STRC	National Institute for the Sciences and Technologies of the Sea (INSTMS), Station de Protection et de Soin des Tortues Marines Monastir, Route de Khniss, 5000 Monastir, B.P. 59, Tel.: (+216) 73–531867, Contact persons: Kaouthar Maatouk, Email: <a href="mailto:maatoukk@yahoo.fr">maatoukk@yahoo.fr</a> , Olfa Chaieb, Email: <a href="mailto:olfa.chaieb@instms.mrt.tn">olfa.chaieb@instms.mrt.tn</a> . (Imed Jribi, University of Sfax, Faculty of Sciences, personal communication, 24 Jan./7 Feb. 2014).
Turkey, TUR	42	STRC	DEKAMER, Sea Turtle Research, Rescue and Rehabilitation Centre, Dalyan, Muğla, <a href="http://caretta.pamukkale.edu.tr/">http://caretta.pamukkale.edu.tr/</a> , Contact person: Yakup Kaska, Email: <a href="mailto:caretta@pau.edu.tr">caretta@pau.edu.tr</a> , <a href="mailto:dekanere@pau.edu.tr">dekanere@pau.edu.tr</a> , Tel.: (+90) 252–2890077, Cell: (+90) 533–5735339. Affiliated with Pamukkale University.

number of facilities seems adequate. We take fisheries bycatch—the most important source of anthropogenic sea turtle mortality at sea—as a proxy for threats (Lutcavage et al. 1997, Casale 2008, Casale 2011).

## Methods

### **Sea turtle rescue facilities currently in operation in the Mediterranean**

Kasperek's (2001) and RAC/SPA's (2004) earlier lists of STRCs served as a starting point for our compilation. Casale and Margaritoulis (2010) and RAC/SPA's List of Focal Points for SPAs provided useful information on potential contact persons and their email addresses. We searched for Mediterranean rescue facilities (STRCs and FASTs) on the internet between August 2012 and March 2014 using Google Search and Duck Duck Go. Searching for phrases such as “list of Mediterranean sea turtle rescue centers”, “first aid stations for marine turtles”, “sea turtle rescue”, and respective variants in English, French, Italian, and Spanish yielded abundant information. Much, however, was incomplete, outdated, and difficult to substantiate, i.e., gray literature, websites without “date of latest update”, or PDFs without mastheads.

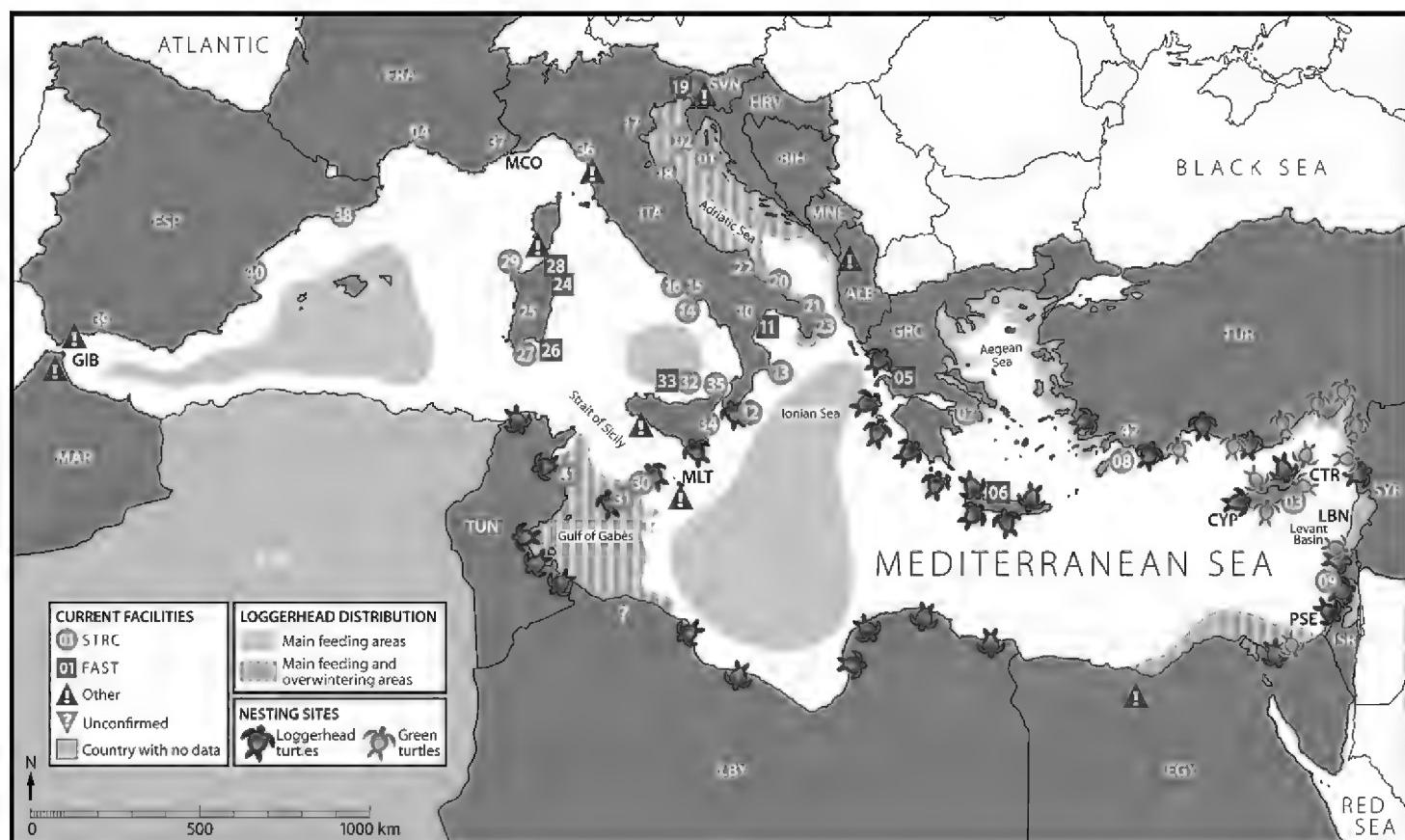
The next step involved obtaining full contact details by sending inquiries directly to the centers. When basic contact information was lacking or no data were available for a particular country, we sent inquiries to official institutions, i.e., ministries of the environment, animal welfare organizations, universities, and national park administrations. We also asked the rescue center contacts about other facilities in their vicinity.

### **Sea turtle distribution, threat hotspots, and coverage with rescue facilities**

We reviewed the peer-reviewed literature to identify the key distribution areas, i.e., nesting beaches, feeding and overwintering areas, foraging sites of juveniles, and major migration corridors, of loggerhead and green turtles.

We also reviewed the peer-reviewed literature to identify threat hotspots for sea turtles in the Mediterranean. Of the commonly acknowledged main threats, i.e., nesting habitat degradation, bycatch, ship strikes, and direct exploitation, we chose fisheries bycatch as a proxy for threats because: 1) it affects primarily older individuals and has great impact on population levels; 2) bycatch and its geographic distribution are quantifiable; 3) it occurs Mediterranean-wide and year-round; 4) its effects can be mitigated by STRCs. We briefly discuss the main deployment areas of the three critical fishing gear types, i.e., trawl, drifting longline, set nets (Lucchetti and Sala 2010).

To better visualize the geographic coverage of rescue facilities and its appropriateness, we compare current locations of rescue facilities to 1) key sea turtle distribution areas (Fig. 1), 2) bycatch hotspots in the three crucial gear types (Fig. 2), and 3) RAC/SPA's (2004) proposed rescue network (Fig. 2).



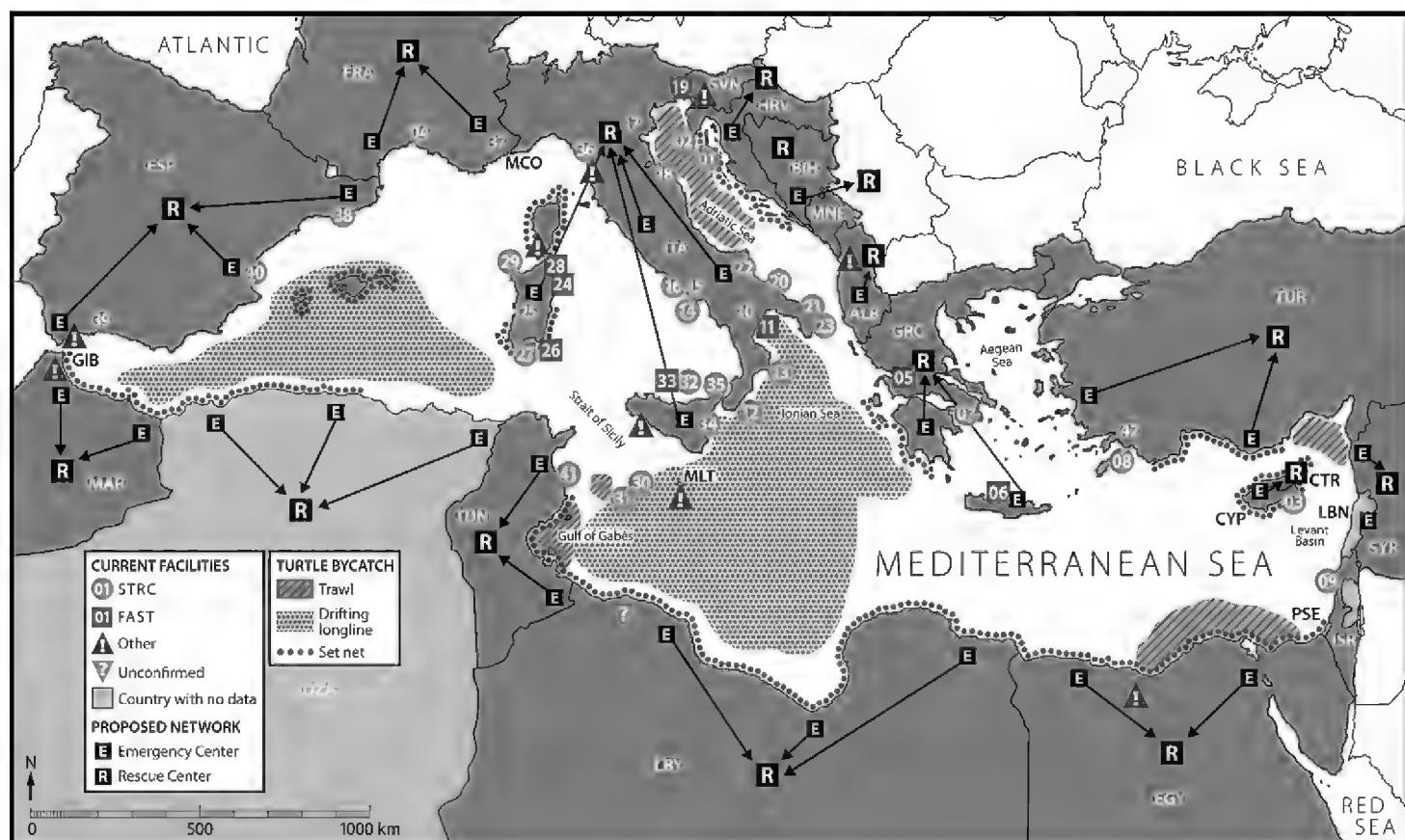
**Figure 1.** Current sea turtle rescue facilities in relation to nesting sites and distributional hotspots. Locations of rescue facilities are based on available internet data and personal communications; latest update: April 2015. Sea turtle distribution and nesting sites combined and modified in part after Gerola and Casale (1999), Kasperek et al. (2001), Margaritoulis et al. (2003), Mingozi et al. (2007), Casale and Margaritoulis (2010), Echikhi et al. (2012), Schofield et al. (2013), Stokes et al. (2015). For country abbreviations, contact details, and additional information on facilities see Table 1. FAST, First Aid Station; STRC, Sea Turtle Rescue Center.

## Results and review of current status

### Sea turtle rescue facilities currently in operation in the Mediterranean

The literature and internet search for rescue facilities yielded 34 STRCs, eight FASTs, and seven informal or temporary rescue institutions (Table 1, Figs 1–2). Based on website content and personal communications, we assumed that the listed STRCs and FASTs adhere to RAC/SPA's code of conduct.

Italy held 21 STRCs, six FASTs, and one informal rescue facility. Spain had three STRCs, Croatia and Greece each had two STRCs, the latter also featuring two FASTs. France held one STRC and a local rescue network in Corsica. Cyprus, Israel, Monaco, Tunisia, and Turkey held one STRC each. Malta held a temporary rehabilitation center. While Egypt, Gibraltar, Morocco, and Slovenia did not have any formal rescue facilities, injured turtles were cared for by veterinarians, local animal welfare organizations and rescue associations. Albania, Bosnia and Herzegovina, Montenegro, Northern Cyprus, and Syria had no facilities. Data for Libya were available but could not be verified. For Algeria, Lebanon, and the State of Palestine, no data on rescue facilities were found and no official institutions reached.



**Figure 2.** Current sea turtle rescue facilities in relation to the proposed network and bycatch hotspots. Locations of rescue facilities are based on available internet data and personal communications; latest update: April 2015. Proposed network after RAC/SPA (2004). Bycatch areas combined and modified in part after Lucchetti and Sala (2010) and Echewikhi et al. (2012). Detailed geographic data on set net bycatch not available for all shorelines. For country abbreviations, contact details, and additional information on facilities see Table 1. FAST, First Aid Station; STRC, Sea Turtle Rescue Center.

## Sea turtle distribution

Ninety-nine percent of green turtle nesting takes place in Turkey and Cyprus (Kasperek et al. 2001) (Fig. 1). The five most important nesting beaches are located in the east of Turkey close to Syria, and on the northern coast of Cyprus. Minor nesting activity also occurs in Syria, Lebanon, Israel, and Egypt (Camiñas 2004, Rees et al. 2008, Stokes et al. 2015) (Fig. 1). Pelagic developmental and neritic habitats were commonly thought to be restricted to the eastern Mediterranean (Levant basin) (Camiñas 2004). Recently, satellite-tagged individuals revealed an important migratory corridor from Turkey and Cyprus to Egypt and Libya, with two major foraging hotspots in the latter country (Stokes et al. 2015).

Loggerhead reproductive habitats and main foraging grounds are concentrated in the wider eastern basin (Casale and Margaritoulis 2010) (Fig. 1). Main nesting sites are located in Greece, Turkey, Cyprus, and Libya but nesting also occurs in Tunisia, Israel, Syria, Lebanon, Italy (Mingozzi et al. 2007), and Egypt (Margaritoulis et al. 2003, Camiñas 2004) (Fig. 1). Loggerheads frequent different habitats during different life stages. As juveniles grow, they are increasingly found in neritic habitats, switching from epipelagic prey caught in oceanic areas to benthic prey (Schroeder et al. 2003, Casale et al. 2008b). Adults show extended fidelity to their neritic feeding

grounds (Broderick et al. 2007). Individuals of the Mediterranean RMU (Wallace et al. 2010) range throughout the basin; Atlantic transients visit foraging habitats in the western Mediterranean.

Continental shelves and slopes constitute the main adult loggerhead feeding areas (Fig. 1). The northern Adriatic is an important foraging area (Casale et al. 2010) for adults from Greek (Lazar et al. 2004, Carreras et al. 2006, Giovannotti et al. 2010, Garofalo et al. 2013) and Turkish rookeries, as well as for juveniles (Casale et al. 2004). Other important areas are the southern Adriatic (Casale et al. 2012a), the Ionian Sea, the Strait of Sicily, and the Tunisian shelf (Margaritoulis et al. 2003, Casale et al. 2007b, Casale et al. 2014). The latter is frequented by turtles from Greek rookeries, Libya, and the Atlantic (Garofalo et al. 2013).

In the central Mediterranean between Italy, Tunisia, and Libya, potential neritic and pelagic foraging habitats are close to each other (Casale et al. 2008b) (Fig. 1). The Pelagie Islands, for example, are a core foraging ground here (Casale et al. 2012b). Individuals from the key Mediterranean turtle rookeries, i.e., western Greece, Crete, and Cyprus, frequent these central Mediterranean feeding grounds (Margaritoulis et al. 2003, Broderick et al. 2007, Casale et al. 2008a, Zbinden et al. 2008). Other important neritic foraging areas are off southeastern Turkey, the Egyptian coast (Gerosa and Casale 1999), and the Spanish coast (Gómez de Segura et al. 2006).

The Gulf of Gabès (Tunisia, Libya) and the northern Adriatic with their wide shelves are also well-known resting and wintering areas (Camiñas 2004) (Fig. 1). Moreover, the southern Adriatic and to a lesser extent the northern Adriatic and Ionian sea are important developmental areas for loggerheads in the first four years of their lives (Casale et al. 2009). Preferred loggerhead habitats off the Spanish Mediterranean coast are characterized by a large number of juveniles, especially around the Balearic islands during spring and summer (Camiñas and de la Serna 1995) and around Columbretes Island Marine Reserve throughout the year (Gómez de Segura et al. 2003).

The North African coast is apparently an important migratory pathway for loggerheads across the Mediterranean (Broderick et al. 2007, Casale et al. 2012b). Seasonal movements include southbound emigration movements from the northern Adriatic (Lazar et al. 2003, Zbinden et al. 2008, Zbinden et al. 2011) and movements of juveniles in the western Mediterranean (Cardona et al. 2009). The central Mediterranean, in particular the Strait of Sicily, is probably a key route for turtles migrating between the eastern and the western Mediterranean basins (Casale et al. 2007a).

### Threat hotspots (fisheries bycatch)

Casale (2008) estimated the incidental captures of Mediterranean sea turtles by fishing gear at 150,000 per year and the associated mortality at 50,000. The respective values in a more recent analysis remained in the same high range, namely 132,000 and 44,000 (Casale 2011). Camiñas (2004) identified the Spanish and Italian surface longline fisheries, northern Adriatic Italian trawl, Tunisian trawl, Turkish trawl, Mo-

roccan driftnet, and Italian driftnet fisheries as having the highest impact (Fig. 2). The Adriatic and Ionian Seas and the Strait of Sicily show high bycatches by trawlers (Casale et al. 2004, 2007a) and longliners (Deflorio et al. 2005, Casale et al. 2007a) (Fig. 2). The central Mediterranean was recognized as a bycatch hotspot of pelagic longline and bottom trawl fisheries (Jribi et al. 2007, 2008, Casale et al. 2007a, Ech Wikhi et al. 2010, 2012; Fig. 2). Artisanal fisheries are the most important in terms of numbers of boats and fishermen involved (Camiñas 2004, Cambiè 2011). Accordingly, Casale (2011) identified small-scale fisheries (versus large vessels) as a key concern and pinpointed the eastern basin as a hotspot.

## Discussion

Nature conservation and species protection have developed in direct response to the deterioration of many habitats and the decline of many species. Nonetheless, there is a continuing gap between problem recognition in the form of scientific data and specific management actions. Moreover, the process is typically reactive rather than proactive. We proffer that this gap should be the narrowest for endangered flagship species in habitats that are well-defined and have a long history of scientific research. Sea turtles in the Mediterranean are a case in point. Just as the analysis of sea turtle protection coverage (based on nesting sites) revealed clear gaps on a global level (Mazaris et al. 2014), our review (based on rescue center coverage) revealed clear gaps on the Mediterranean level as well.

Compared to the international conventions and protocols of the 1970s that first recognized the problems facing sea turtles in the Mediterranean, most STRCs and FASTs were founded quite late (Suppl. material 1). Moreover, the quality criteria for these facilities were formulated even later (RAC/SPA 2004).

Compared to Kasparek's (2001) and RAC/SPA's (2004) preliminary lists of about a dozen rescue centers, the number of known rescue facilities in the Mediterranean has quadrupled within the last ten years. With nearly 50 facilities today (Figs 1–2), the dimension of RAC/SPA's (2004) proposed rescue network has now been reached. Nonetheless, there are major differences between the proposed network and the current situation, specifically in type and distribution.

Regarding type, RAC/SPA envisaged a network consisting of 16 rescue centers, each connected to between two and four emergency centers (Fig. 2). Currently, however, there are about four times as many STRCs as FASTs. The original proposal might have been based on more FASTs as a more cost-effective solution. One potential explanation for the current proportion, though, is that FASTs proved to be suboptimal because most injured turtles require long-term veterinary treatment in a rescue center. Alternatively, our web-based search might have missed FASTs because they probably have smaller budgets and are less well represented on the internet. This is an invitation to complete and regularly update our list of Mediterranean sea turtle rescue facilities.

Regarding distribution, RAC/SPA's (2004) proposal for an even spread along the Mediterranean coasts has not been realized. For example, whereas the original pro-

posal indicated 17 facilities along the southern Mediterranean coastline (5 STRCs, 12 FASTs), only 3 are currently confirmed. The distribution along the northern coast more closely resembles RAC/SPA's proposal. Once Albania's planned STRC (Table 1) is in effect, the same will hold true for the eastern Adriatic. Nonetheless, some regions (Italy) exhibit numerous closely adjoining STRCs, while others have long stretches without a single facility.

More than half (28) of all facilities are concentrated in Italy. This is the best fit because the total estimated bycatch there ( $23,600 = 18\%$ ; Casale 2011) is the highest of any Mediterranean country. Spain, with the second highest bycatch ( $20,920 = 16\%$ ) is covered by only 3 facilities. Nonetheless, Spain shows the best agreement in facility number and location with RAC/SPA's proposal (Fig. 2). The third, fourth and fifth highest bycatches are reported for Tunisia ( $17,600 = 13\%$ ), Morocco ( $15,400 = 12\%$ ), and Turkey ( $12,900 = 10\%$ ). Here the correlation is extremely poor, each country having only a single facility. This is particularly evident in the case of Turkey, which hosts many key nesting beaches but has only one very recently established STRC. Overall, there is a pronounced shortage of facilities along the Middle East and African Mediterranean coasts, especially when considering that Casale (2011) identified the North African continental shelves, the Levantine basin and the Aegean Sea as the areas in which sea turtles were most at risk from bottom trawling, demersal longlines, and set nets.

The deficits in STRC numbers and distribution no doubt partially reflect the different cultures, socio-economic status, funding priorities and perception of environmental issues of the 22 Mediterranean countries. It is further compounded by security issues in many countries (Amano and Sutherland 2013). Along with language barriers, these factors are also a hindrance to the originally envisioned concept of a functioning network. In many cases there seems to be limited knowledge about and communication between neighboring centers—within and across borders. This was detected at the national level, e.g., in the 15 Italian administrative regions with access to the sea, and even at local level, i.e., two facilities in one town. Clearly, knowledge of neighboring institutions and communication between centers are key ingredients for successful collaboration on the national level, which in turn is a prerequisite for rewarding international cooperation.

What are the repercussions for the current status of Mediterranean sea turtles? Primarily, suboptimal species protection. Injured individuals with chances of survival are not being detected and not receiving the necessary veterinary care. Each adult turtle is thought to represent one surviving individual out of an estimated 500–1000 hatchlings that emerge from their nests on the beach. This, coupled with the life history of sea turtles—slow growth, long period before sexual maturity—means that every adult is very important. Considering the historical decline in sea turtle numbers and the present low numbers, the mortalities must be reduced. We must avoid the situation—known for cetaceans such as the vaquita in the Gulf of California, the Western Pacific gray whale, or the North Atlantic right whale—that further human-induced mortalities of any individual, in particular adult females, will jeopardize species or population survival (Kraus et al. 2005). This is precisely where the role of STRCs grasps: every rescued individual counts.

What is the vision for the future and how can this be achieved? The goal must be to work toward a dense and evenly distributed rescue facility network. Communication between centers must be improved. This will not only help rescue individual sea turtles but will provide added benefits—in a positive feedback loop—for the other STRC functions, namely research and public outreach (RAC/SPA 2004). What species and life stages are being treated and what injuries are being suffered in what regions? The actual overall numbers of treated and saved individuals—related to the number of nesting females—is the first important data set that STRCs could deliver. STRCs are eminently suited to provide answers, which are currently not available and which are not necessarily supplied by today's hypothesis-driven scientific literature (Casale and Margaritoulis 2010). Such information, compiled Mediterranean-wide and collated by a coordinating level, can then be translated into improved management. The relatively small size of the Mediterranean may actually help in collecting such information: many critical areas are located within Exclusive Economic Zones, simplifying data collection and promoting a sense of responsibility.

Such data could best be compiled using a common online database. This is a viable option based on our experience at the level of individual STRCs: most contacted rescue center staff were readily willing to help, seemed interested in information dissemination, and eager for news about other facilities. We therefore support setting up a “Mediterranean Sea Turtle Rescue Network Database” online, containing and updating all the basic information on rescue facilities (Table 1). The idea of an internet gate or special webpage for communication, containing publicly available profiles of existing rescue facilities, is not new (Kasperek 2003, Panagopoulou and Rees 2009, also see Suppl. material 1). The online database could be hosted by recognized pan-Mediterranean institutions, e.g., RAC/SPA or EuroTurtle, ensuring a wide audience from the onset. It would be an inexpensive yet effective tool for adequate coordination and monitoring of rescue and conservation efforts. Beyond facilitating communication among sea turtle specialists, marine scientists and non-professionals, it would help standardize data collection and presentation.

## **General conclusions**

Our review shows that sea turtle rescue facilities—as visible and measurable evidence of concrete conservation action—are characterized by a:

- a) relatively late start in light of early conventions and protocols addressing sea turtle threats,
- b) relatively late set of quality criteria,
- c) slow increase in number,
- d) patchy distribution with major unserviced regions,
- e) often haphazard rather than problem-oriented correlation between sea turtle distribution/threat hotspots and rescue facility sites,

- f) still insufficient number,
- g) poor readily available information on and suboptimal communication between these facilities.

Information on the number of treated turtles and their injuries is essential input for further, well-targeted, and concerted conservation measures. At the same time, we must go beyond the often heard call for more data and apply common sense to the ongoing threatened status of sea turtles in the Mediterranean and elsewhere. Further action should not be delayed until further evidence has been collected. A functioning network of sea turtle rescue centers would be a good first step in this direction.

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## **Supplementary material I**

### **Stepping stones toward a Mediterranean sea turtle rescue network**

Authors: Judith Ullmann, Michael Stachowitsch

Data type: species data

Explanation note: Historical outline of sea turtle protection in the Mediterranean.

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